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NOTES ON GEOGRAPHIC DISTRIBUTION

Range Extension of *Eleutherodactylus cooki*, the "Coqui Guajon", Grant, 1932 (Amphibia: Eleutherodactylidae)

Norman Greenhawk

Tropic Ventures Research and Education Foundation, Las Casas de la Selva, HC-63, Buzon 3879, Route 184, KM 15.9, Patillas, Puerto Rico 00723.
E-mail: *greenhawk81@gmail.com*

ABSTRACT: *Eleutherodactylus cooki*, the "Coqui Guajon", is a frog endemic to the southeastern portion of the island of Puerto Rico. Due to highly specialized habitat requirements and limited range, *Eleutherodactylus cooki* is listed on the US Endangered Species List as Threatened. Several individuals of this species were observed during four herpetological surveys in the Icaco Valley within the ward of Mullas in Patillas, Puerto Rico. These observations expand the confirmed range of this species.

Eleutherodactylus cooki, the "Coqui Guajon" is an eleutherodactylid frog endemic to the southeastern region of Puerto Rico. The species is petricolous and has highly specialized habitat requirements, being found only in guajonales, caves in the rocks along rivers. Additionally, *E. cooki* is sometimes found in smaller crevices in rock formations adjacent to rivers.

Eleutherodactylus cooki is the second largest frog in Puerto Rico (Rivero 1998). The mean SVL is 50.94 mm for females and 43.43 mm for males (USFWS 2004). The dorsal color is brown, and the species exhibits sexual dimorphism; the males have a bright yellow throat and are considerably smaller than the females, making for easy gender identification. *Eleutherodactylus cooki* mates throughout the year, with females producing a clutch of eggs every two months (Burrows 2000). Clutches are cared for by males and undergo direct development. Males have been observed guarding up to four clutches of eggs at a time (Burrows 2000).

Eleutherodactylus cooki was listed as threatened on the United States Endangered Species List on June 11, 1997 due to the specialized nature of the species' habitat requirements and its restricted area of distribution, compounded by pressure on the species from deforestation and habitat degradation (USFWS 2004).

The Puerto Rican GAP Analysis Project (PR GAP) is a comprehensive database of information pertaining to land cover and animal occurrences in Puerto Rico. PR GAP states the confirmed range for *Eleutherodactylus cooki* as being in the Sierra Panduras or Cuchilla de Panduras mountain range (Gould *et al* 2007). The survey area, known locally as Icaco Valley, falls within Hexagon 1103 on the PR GAP's Occurrence Map for *E. cooki*. This hexagon is labeled as an area of "probable" occurrence (Gould *et al.* 2007). A denotation of "probable" for a hexagon indicates that *E. cooki* is likely to occur in that area, but its presence has not been confirmed (Figure 1).

Icaco Valley is part of the land known as Las Casas de la Selva, a 404.68 ha sustainable forestry project in Patillas, southeastern Puerto Rico. Founded in 1983, the mission of Las Casas de la Selva is to demonstrate that second-growth tropical forests can be managed for timber production in ways that generate income while preserving the resource base and providing habitat for wildlife (Nelson *et al.* 2010).

The area surveyed extends 1.3km along the valley river, known locally as Quebrada Icaco, starting at 18°03'44.81"N/66°01'21.67"W (elevation 254.81 m) and ending at 18°03'58.97"N/66°01'01.73"W (elevation 387.10 m) (Figure 2).

From 1984 to 1989, Mahogany trees (*Swietenia mahogani* X *Swietenia macrophylla*) were line planted in the forest along the river banks in the lower elevations of Icaco. These trees, along with native pioneer species such as *Cecropia peltata* and *Schefflerra* spp., form the canopy of the forest in much of the valley. The canopy is closed, resulting in a shaded understory adjacent to the river, although the river is in full sun. The topography is generally very steep; in some areas there is no bank and the sides of the valley rise almost vertically out of the river. The river is shallow, with water depths between approximately 0.5 - 1 m, and can be traversed without having to swim. The substrate consists of a sand-and-cobblestone bottom, with large boulders interspersed both within the river and along the banks (Figure 3).

The majority of the guajonales explored for the purposes of this survey are small, most of them too small for a human to fit completely inside, although entrance from the head to the waist was usually possible. Most of the guajonales located along the river bank have a sandy floor, with the walls and ceiling composed of rock. All guajonales examined were directly at the river's edge.

The area was surveyed on four separate occasions in 2011 and 2012 in Icaco Valley for general herpetological surveys. The purpose of the surveys was to form a comprehensive list of amphibians and reptiles of the valley as part of an ongoing herpetological survey for the entire property of Las Casas de la Selva. Frogs were captured, measured, photographed, and released at the point of capture. Photos were sent via email to Dr. Patricia Burrowes at the University of Puerto Rico, Rio

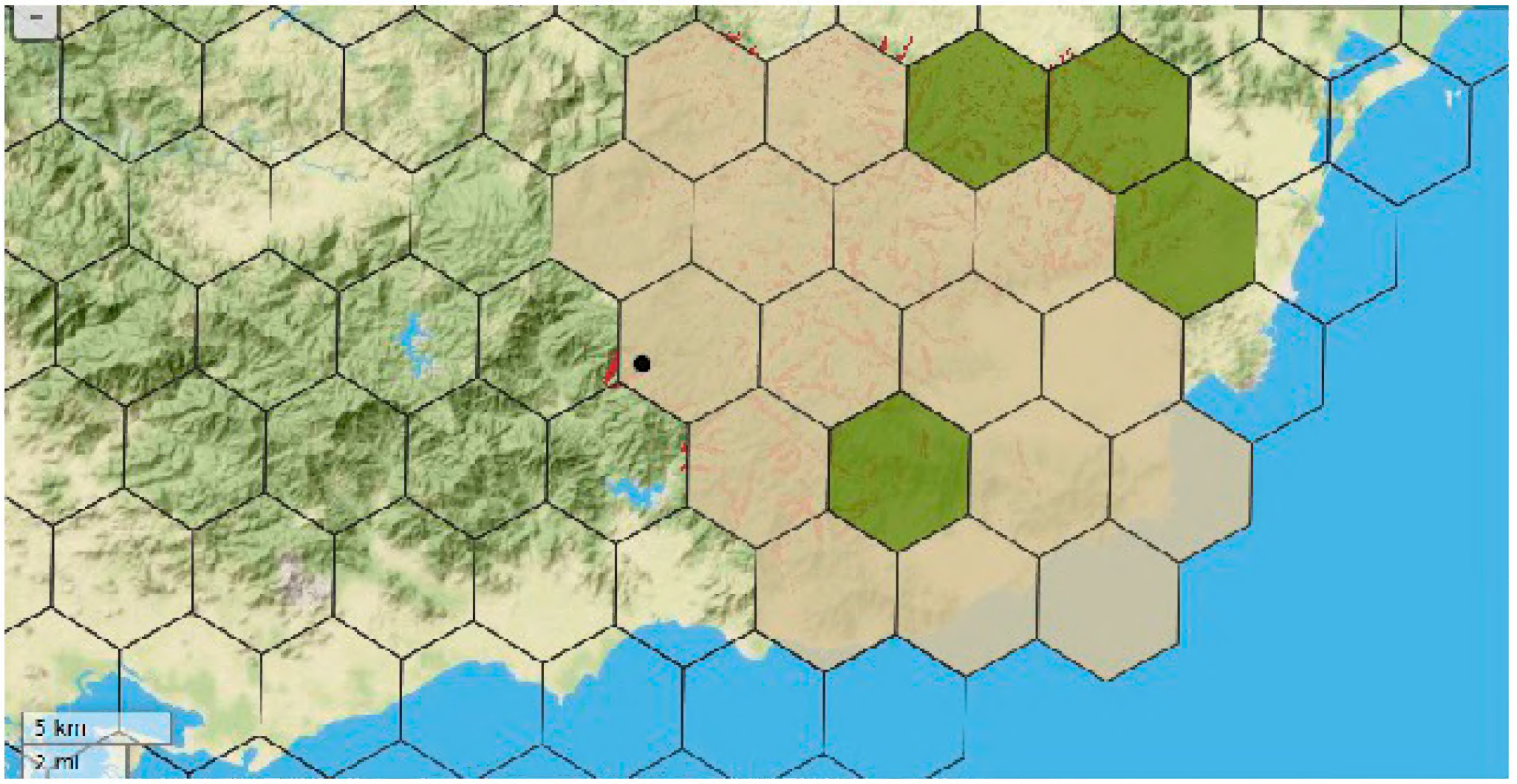

FIGURE 1. Figure 1- Puerto Rican Gap Analysis Project Probable Occurrence Map for *Eleutherodactylus cooki*. Green hexagons indicate areas of confirmed occurrence for E. cooki. Beige hexagons indicate areas of probable occurrence. Black dot indicates study area.

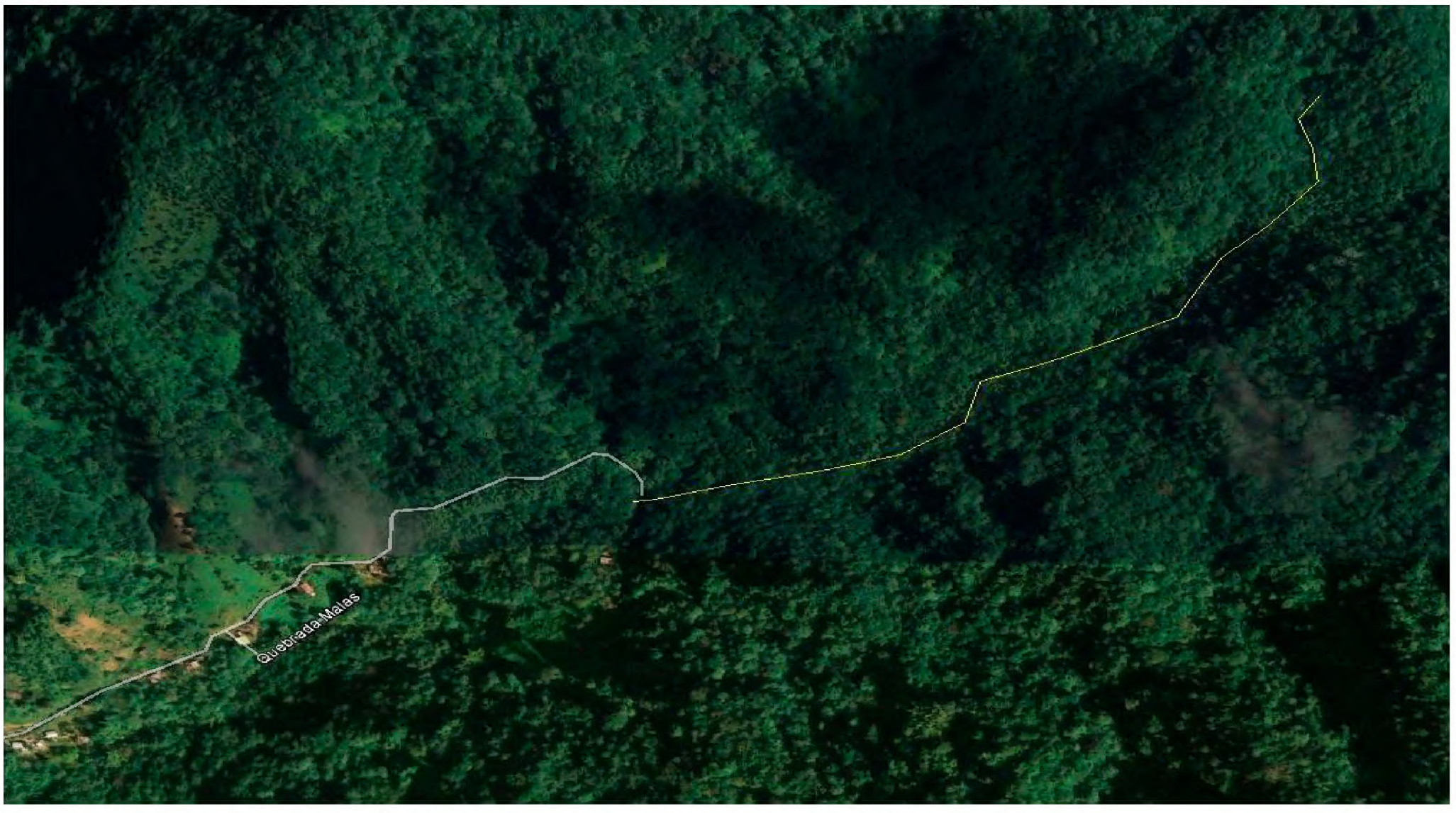

FIGURE 2. Icaco Valley. The yellow line denotes the survey path along the river. Image from Google Earth.

Piedras campus for positive identification confirmation. No other species of frogs were found in the guajonales during the surveys.

When searching for *E. cooki*, volunteers used headlamps to look inside every encountered guajonal. Volunteers also listened for the mating calls of the males.

On 29 December 2011 at 08:47 h a single specimen of *E. cooki* was captured during a survey conducted with a group of Earthwatch volunteers. The specimen was a female, SVL 44 mm.

On 24 March 2012, a survey was conducted with four students from the University of Puerto Rico, Rio Piedras campus. Between 17:47 h and 19:16 h, 10 specimens of *E. cooki* were identified, six females, four males. The first specimen encountered during the survey is believed to be the same specimen that was identified on 29 December 2011, as it was a female, SVL 44 mm, found in the same guajonal. This specimen was gravid; eggs were visible in her abdomen.

Two of the specimens, a male and female, were found in a guajonal not on the river bank, but in the river itself. All others were found in guajonales along the river bank.

Five specimens were captured, with an SVL range of 39 - 48mm, mean SVL 43.80 mm. Mean temperature during the survey was 23.4°C, average humidity was 93.6%.

On 08 June 2012, a third survey was conducted from 17:30 h to 20:00 h with a group of Earthwatch volunteers. During this survey, six specimens of *E. cooki* were identified, but none were captured, mainly because of safety concerns regarding the structural integrity of the guajonales being explored during this survey. Of the six specimens, one was a juvenile, the other five were males. The males were located by listening for their mating calls, and no females were observed during this survey. Two males were found not at the river's edge, but approximately 3.35 m away. The specimens were not in a guajonal, but in an eroded hole in the highly impacted clay of river bank, held together with small rocks and the roots of a tree. The hole was large enough for the investigator to fully fit inside. Mean temperature during this survey was 24°C, average humidity was 86.2%.

On 23 June 2012, the fourth survey was conducted from 11:30 h to 17:00 h with a group of Earthwatch volunteers. During this survey, 21 specimens were observed, 16 of which had recently hatched from eggs attached to the wall of a guajonal. Of the five remaining specimens, four were males, one was a female. Of the four males, three were guarding clutches of eggs, the fourth male was found near the female in the same guajonal as the hatching egg clutch.

As with the previous survey, safety concerns did not allow for the capture of every identified specimen. The SVL range of the three specimens that were captured was 41 - 49mm, mean SVL 42.66 mm.

Photographs of a male and female specimen of *E. cooki* are in Figures 4 and 5. A photograph of the hatching neonates is in Figure 6.

The survey area falls within Hexagon 1103 on the Puerto Rico Gap Project's Occurrence Map for *E. cooki*. This hexagon is labeled as an area of "probable" occurrence (Gould *et al.* 2007). The findings of this investigation confirm the presence of *E. cooki* within this hexagon. The new records for E. cooki extend the known range approximately 10 km northwest from the nearest PR GAP hexagon of confirmed occurrence, Hexagon 1182. Furthermore, this record is the first confirmation of the occurrence of *E. cooki* in the Icaco Valley watershed.

FIGURE 3. The river at the bottom of the Icaco Valley survey area. Photograph by N Colon.

FIGURE 4. Male *Eleutherodactylus cooki*, SVL 39 mm, captured on 24 March 2012. Photograph by N Colon.

FIGURE 5. Female *Eleutherodactylus cooki*, SVL 45mm, captured on 24 March 2012. Photograph by N Colon.

Habitat in the Icaco valley is similar to that reported for *E. cooki* in other locations.

In addition, this record is of note for conservation purposes. *Eleutherodactylus cooki* is listed as threatened on the US Endangered Species List in part due to pressures from deforestation (USFWS 2004). The area of Icaco Valley where these surveys were conducted is second-growth forests intermixed with line-planted timber trees; few of the trees are over thirty years in age (Nelson *et al.* 2010). Thus, the presence of *E. cooki* in this area demonstrates that properly managed second-growth forests may play a role in conservation efforts of this species.

Future research concerning the presence of *E. cooki* in Icaco Valley will be conducted in three stages: (1) obtain a baseline population count by establishing transects along the river (2) survey the transects quarterly to monitor the stability of the population of *E. cooki* in Icaco valley, and (3) collect data on microhabitat, such as temperature and humidity levels inside the guajonales vs. outside, as well as depth and width of the guajonales.

Future research will be conducted with the help of students from Universidad de Puerto Rico, Rio Piedras, Universidad de Puerto Rico, Mayaguez, and Universidad del Turabo, as well as volunteers from The Earthwatch Institute.

FIGURE 6. From left to right: Hatching metamorphs and eggs, female, and male *E. cooki*. Observed on 23 June 2012. Photograph by N Tepper.

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